Approved For Release 2006/06/23 : CIA-RDP78B04770A000800090006-0

July 1, 1964

TITLE:

Summary of Microdensitometer Derived Image Quality Data Collected from Mission 1006-1

SECTION I: INTRODUCTION

Microdensitometer tracing of scene edges has been used as an objective technique for evaluating photographic system performance. In this report, the evaluation data is presented as spread function width in microns and resolving power in lines per millimeter. A statistical summary of the edge data is presented in Section II, giving the arithmetic mean, standard deviation, coefficient of dispersion, and number of edges. Section III is a tabulation of the location, description, and image quality data for each edge. Frequency plots of the spread function and resolving power data are presented as Section IV, to show the distribution of values.

Section V is included to show the sensitometric data for this mission.

Appendix A is a diagram of the reference system used in describing the orientation of an edge. The edge orientation is recorded as the angular rotation of the edge in a clockwise direction away from a line parallel to the longitudinal direction of the strip of film. Appendix B is a temporary coordinate system used to locate the edges within a frame. A revision of the grid coordinate system is under study.

The image quality data was obtained from sharp scene edges in the original negative by scanning with a [redacted] Model 5 microdensitometer. A 1 X 320 micron slit was used. The data reduction consisted of the following steps: STAT

(a) hand smoothing of the microdensitometer strip chart recording,

(b) key punching of chart (density) values at sample distance increments of 0.277 microns,

(c) I.B.M. 1620 computer conversion of chart values to relative exposure values, and

(d) computer conversion of exposure data to line spread function and modulation transfer function by numerical methods.

The edge resolving power was predicted graphically as the intersection of the MTF curve and the aerial image modulation curve for 4404 film at a test object contrast of 2:1. The spread

DDR-DUPE

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function width was calculated from the first differences of relative exposure as the width at which the gradient became 50% of the maximum gradient.

Analysis of Photographic Image to Evaluate System Performance

SECTION II SUMMARY SHEET

Mission 1006-1

Resolution in lines/mm based on the aerial image modulation - 4404 curve from edge trace data reduced by computer techniques.

Arithmetic Mean	85.3
Standard Deviation	26.4
Coefficient of Dispersion	31.%
Number of edges	93.

Spread function width at 50% amplitude in microns from edge trace data reduced by computer techniques.

Arithmetic Mean	12.0
Standard Deviation	4.3
Coefficient of Dispersion	36.%
Number of Edges	93.

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Analysis of Photographic Image to Evaluate System Performance

Mission 1006-1

Section III

Edge No.	Camera	Pass	Frame	Location	Orientation	Subject	50% Amplitude Spread Function Width (Microns)	A.I.M. Resolution
1A	Aft.	D07	010	B-8	15	Airfield	15.8	50
2A	Aft.	D07	025	A-9	160	Building	13.9	61
3	Aft.	D09	060	C-5	60	Airfield	15.3	80
3A	Aft.	D09	060	C-5	60	Airfield	6.5	128
4	Aft.	D09	038	A-9	120	Airfield	9.6	84
4A	Aft.	D09	038	A-9	120	Airfield	8.4	99
5	Aft.	D09	038	A-9	120	Airfield	8.8	102
5A	Aft.	D09	038	A-9	120	Airfield	10.1	99
6	Aft.	D09	034	C-3	130	Airfield	14.2	55
6A	Aft.	D09	034	C-3	130	Airfield	18.7	49
7	Aft.	D09	034	C-3	130	Airfield	15.9	66
7A	Aft.	D09	034	C-3	130	Airfield	13.4	62
8	Aft.	D21	084	B-2	120	Airfield	17.9	40
8A	Aft.	D21	084	B-2	120	Airfield	21.1	39
9	Aft.	D21	087	B-5	90	Airfield	11.3	71
9A	Aft.	D21	087	B-5	90	Airfield	11.0	75
10	Aft.	D21	087	A-7	90	Airfield	6.6	127
10A	Aft.	D21	087	A-7	90	Airfield	6.9	120
11	Aft.	D21	088	A-8	90	Airfield	11.0	87
12	Aft.	D21	106	A-4	40	Airfield	6.6	126
12A	Aft.	D21	106	A-4	40	Airfield	9.1	98

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Edge No.	Camera	Pass	Frame	Location	Orientation	Subject	50% Amplitude Spread Function Width (Microns)	A.I.M. Resolution
13	Aft.	D21	125	C-4	40	Airfield	14.4	100
13A	Aft.	D21	125	C-4	40	Airfield	11.5	88
14	Aft.	D24	124	B-3	20	Airfield	14.5	63
14A	Aft.	D24	124	B-3	20	Airfield	12.8	63
15A	Aft.	D24	124	B-3	20	Airfield	10.2	77
16-1	Aft.	D37	085	C-4	100	Airfield	11.2	111
16-2	Aft.	D37	085	C-4	100	Airfield	15.4	75
16A-2	Aft.	D37	085	C-4	100	Airfield	12.8	62
17	Aft.	D52	080	C-9	170	Airfield	8.9	107
17A	Aft.	D52	080	C-9	170	Airfield	11.3	84
19	Fwd.	D09	029	B-12	140	Airfield	12.5	60
19A	Fwd.	D09	029	B-12	140	Airfield	12.1	59
20-1	Fwd.	D09	029	B-5	100	Airfield	16.0	86
20A-1	Fwd.	D09	029	B-5	100	Airfield	19.0	88
20-2	Fwd.	D09	029	B-5	100	Airfield	19.4	37
20A-2	Fwd.	D09	029	B-5	100	Airfield	26.8	39
21	Fwd.	D09	033	C-7	70	Airfield	8.7	127
21A	Fwd.	D09	033	C-7	70	Airfield	13.0	59
22	Fwd.	D09	055	C-9	80	Airfield	6.0	125
22A	Fwd.	D09	055	C-9	80	Airfield	17.1	52
23	Fwd.	D09	055	C-9	80	Airfield	14.5	57
23A	Fwd.	D09	055	C-9	80	Airfield	9.0	135

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Edge No.	Camera	Pass	Frame	Location	Orientation	Subject	50% Amplitude Spread Function Width (Microns)	A.I.M. Resolution
24	Fwd.	D21	121	A-10	30	Airfield	7.6	90
24A	Fwd.	D21	121	A-10	30	Airfield	7.5	127
25	Fwd.	D21	084	C-11	80	Airfield	10.8	94
26	Fwd.	D21	083	C-8	90	Airfield	12.0	83
26A	Fwd.	D21	083	C-8	90	Airfield	6.3	90
27	Fwd.	D21	083	A-9	100	Airfield	9.0	100
28	Fwd.	D21	080	B-4	120	Airfield	12.5	93
28A	Fwd.	D21	080	B-4	120	Airfield	6.1	134
29	Fwd.	D21	158	C-12	30	Airfield	11.8	70
29A	Fwd.	D21	158	C-12	30	Airfield	9.3	82
30	Fwd.	D21	158	C-12	30	Airfield	13.5	61
30A	Fwd.	D21	158	C-12	30	Airfield	13.0	84
31	Fwd.	D21	159	C-13	30	Airfield	9.1	108
31A	Fwd.	D21	159	C-13	30	Airfield	8.3	125
32	Aft.	D25	067	C-5	130	Airfield	11.0	100
32A	Aft.	D25	067	C-5	130	Airfield	8.9	92
33	Aft.	D25	024	A-2	10	Airfield	15.6	53
33A	Aft.	D25	024	A-2	10	Airfield	10.7	73
34A	Aft.	D25	020	A-13	115	Airfield	10.9	107
35	Aft.	D25	018	A-B-10	110	Airfield	11.0	95
35A	Aft.	D25	018	A-B-10	110	Airfield	8.8	103
36	Aft.	D25	013	A-6	170	Airfield	9.0	81

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Edge No.	Camera	Pass	Frame	Location	Orientation	Subject	50% Amplitude Spread Function Width (Microns)	A.I.M. Resolution
37	Aft.	D40	041	A-1	100	Airfield	9.8	96
37A	Aft.	D40	041	A-1	100	Airfield	9.6	96
38	Aft.	D38	037	B-8	45	Building	5.2	133
38A	Aft.	D38	037	B-8	45	Building	6.4	122
39	Aft.	D38	037	A-8	0	Canal Edge	14.5	90
39A	Aft.	D38	037	A-8	0	Canal Edge	10.7	80
39B	Aft.	D38	037	A-8	0	Canal Edge	6.5	123
40	Fwd.	D07	005	B-7	45	Airfield	12.2	80
40A	Fwd.	D07	005	B-7	45	Airfield	15.1	81
40B	Fwd.	D07	005	B-7	45	Airfield	15.1	65
41A	Fwd.	D07	027	A-10	120	Buildings	7.7	119
41C	Fwd.	D07	027	A-10	120	Buildings	8.9	119
41D	Fwd.	D07	027	A-10	120	Buildings	7.5	133
42	Fwd.	D24	101	C-12	25	Dam	17.3	52
42A	Fwd.	D24	101	C-12	25	Dam	14.5	61
43	Fwd.	D24	101	C-12	115	Building	-	-
44	Fwd.	D24	104	B-12	170	Airfield	14.3	59
44A	Fwd.	D24	104	B-12	170	Airfield	13.2	52
45	Fwd.	D24	120	A-12	30	Airfield	12.8	81
45A	Fwd.	D24	120	A-12	30	Airfield	13.9	98
46	Fwd.	D22	046	B-8	90	Dam	20.9	61
46A	Fwd.	D22	046	B-8	90	Dam	9.9	109
47	Fwd.	D23	001	B-3	90	Dam	30.3	20

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Edge No.	Camera	Pass	Frame	Location	Orientation	Subject	50% Amplitude Spread Function Width (Microns)	A.I.M. Resolution
49	Fwd.	D23	008	A-12	155 All Direct-ions	Airfield	14.7	61
49A	Fwd.	D23	008	A-12	155	Airfield	15.5	82
50	Aft.	D56	038	C-11	120	Airfield	10.0	83
50A	Aft.	D56	038	C-11	120	Airfield	11.3	77
51	Aft.	D56	042	B-7	80	Airfield	11.2	79
51A	Aft.	D56	042	B-7	80	Airfield	8.7	103

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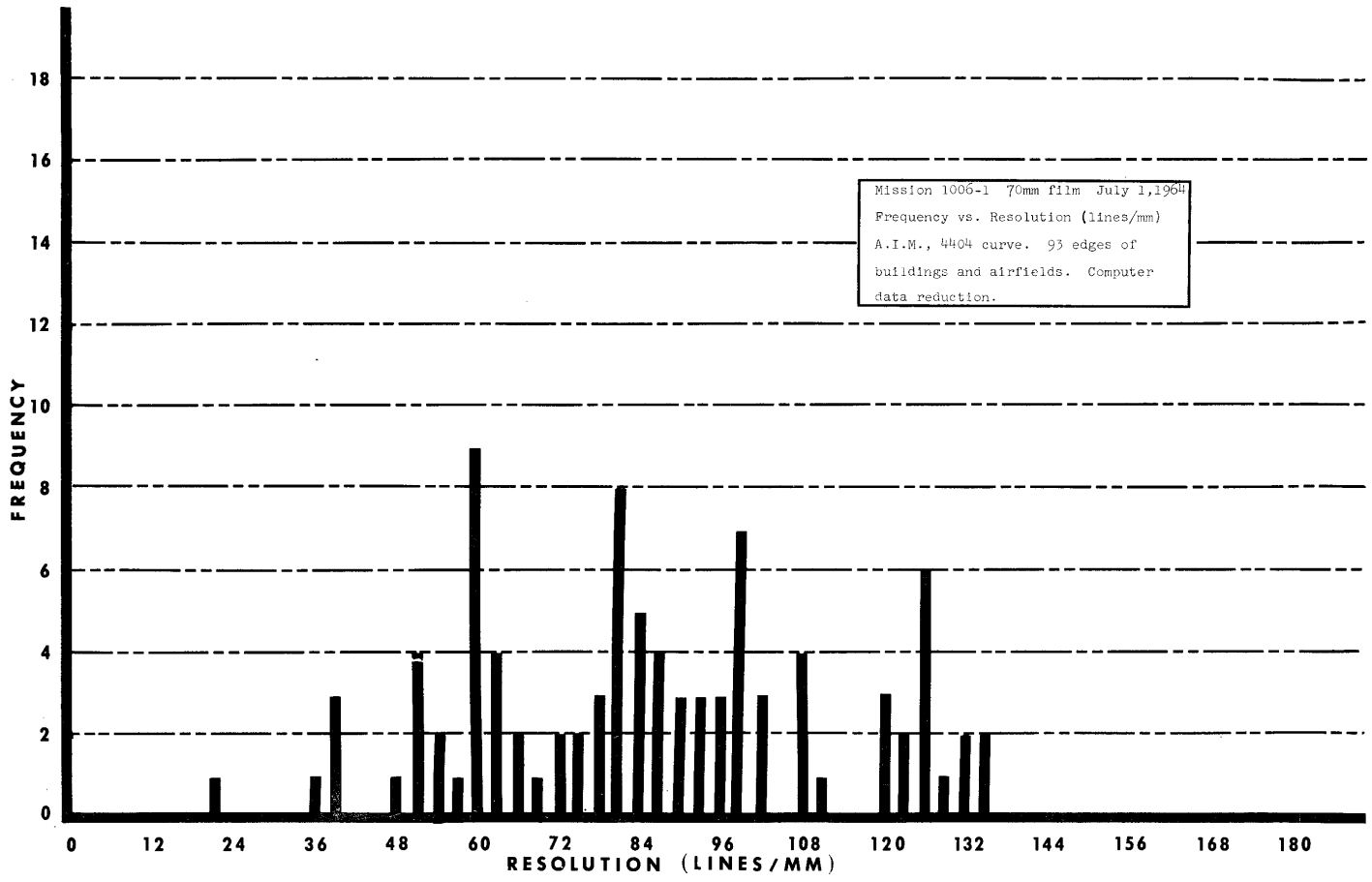

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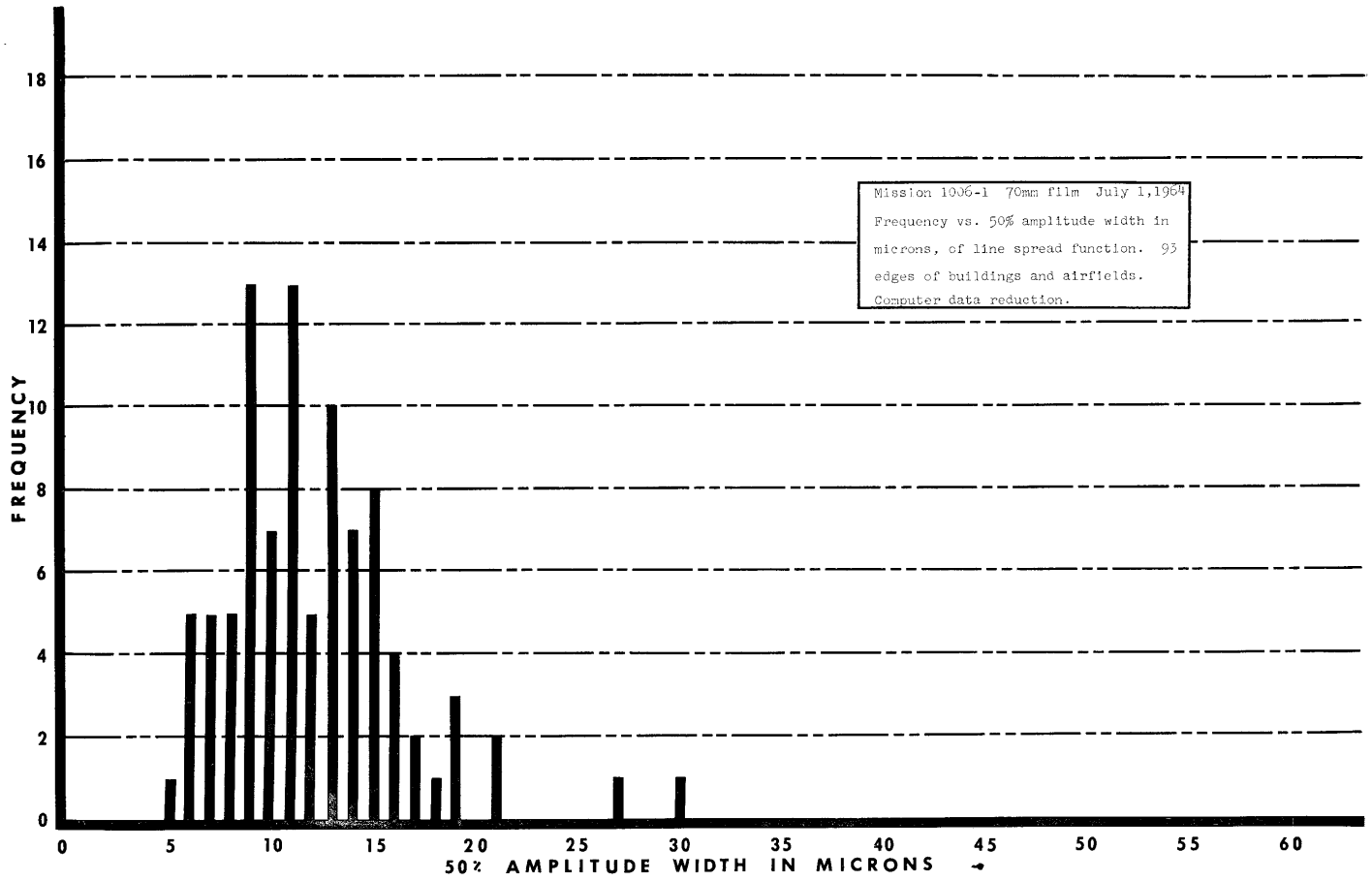

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Sensitometric Data

Mission 1006-1

Film Manufacturer: [redacted] STAT

Exposure Date: May 26, 1964

Emulsion No.: 4404-42

Lamp No.: 1903

Exposure Time: 1/25 second

Wedge No.: 711-15

Filter: Daylight

Development Conditions:

Primary: Pg. - 93, 2' 15", 74°F

Intermediate: Primary Development Plus 12DX90, 25", 67°F

Full: Primary Development Plus 12DX90, 1' 16", 67°F

Absolute Log E 11th Step: $\bar{1}.30$ M.C.S.

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Sensitometric Data

	Process Control Standard			Start Up		
	Primary	Intermed.	Full	Primary	Intermed.	Full
Fog	.08	.10	.19	.07	.09	.19
1						
2						
3						
4						.19
5			.19			.20
6		.10	.20		.09	.22
7	.08	.12	.23	.07	.12	.24
8	.10	.14	.27	.08	.14	.29
9	.12	.18	.34	.12	.18	.37
10	.16	.26	.50	.16	.27	.55
11	.24	.42	.79	.25	.42	.80
12	.38	.67	1.10	.39	.65	1.08
13	.62	1.03	1.43	.61	.98	1.40
14	.93	1.40	1.72	.87	1.34	1.68
15	1.26	1.71	1.95	1.19	1.65	1.91
16	1.55	1.95	2.13	1.50	1.90	2.10
17	1.83	2.10	2.24	1.78	2.09	2.24
18	2.04	2.22	2.30	2.00	2.23	2.33
19	2.17	2.29	2.35	2.16	2.32	2.38
20	2.25	2.34	2.39	2.26	2.36	2.41
21	2.30	2.37	2.43	2.31	2.39	2.43
D	2.15	2.38	2.20	2.14	2.32	2.12

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	Process Control Standard			Start Up		
	Primary	Intermed.	Full	Primary	Intermed.	Full
0.6G/Speed	$\bar{1}.48$	$\bar{1}.30$	$\bar{1}.13$	$\bar{1}.50$	$\bar{1}.33$	$\bar{1}.14$

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	Head and Tail Forward Camera		Head and Tail Aft Camera		Mission Mat'l
	Head	Tail	Head	Tail	Full
Fog	.19	.19	.19	.18	
1					
2					
3					
4					.21
5	.19	.19	.19	.18	.22
6	.20	.20	.22	.20	.24
7	.23	.24	.24	.22	.27
8	.28	.29	.29	.27	.34
9	.37	.38	.38	.36	.45
10	.54	.55	.54	.54	.63
11	.78	.79	.78	.77	.91
12	1.06	1.09	1.06	1.07	1.20
13	1.39	1.41	1.38	1.39	1.47
14	1.67	1.69	1.66	1.68	1.76
15	1.92	1.93	1.91	1.92	1.97
16	2.12	2.12	2.11	2.11	2.15
17	2.25	2.26	2.27	2.26	2.28
18	2.35	2.35	2.37	2.35	2.36
19	2.40	2.40	2.43	2.41	2.42
20	2.43	2.44	2.45	2.43	2.43
21	2.45	2.45	2.47	2.45	2.44
γ	2.00	2.00	2.02	2.02	1.97
0.6G/Speed	$\bar{1}.11$	$\bar{1}.11$	$\bar{1}.12$	$\bar{1}.12$	$\bar{1}.07$

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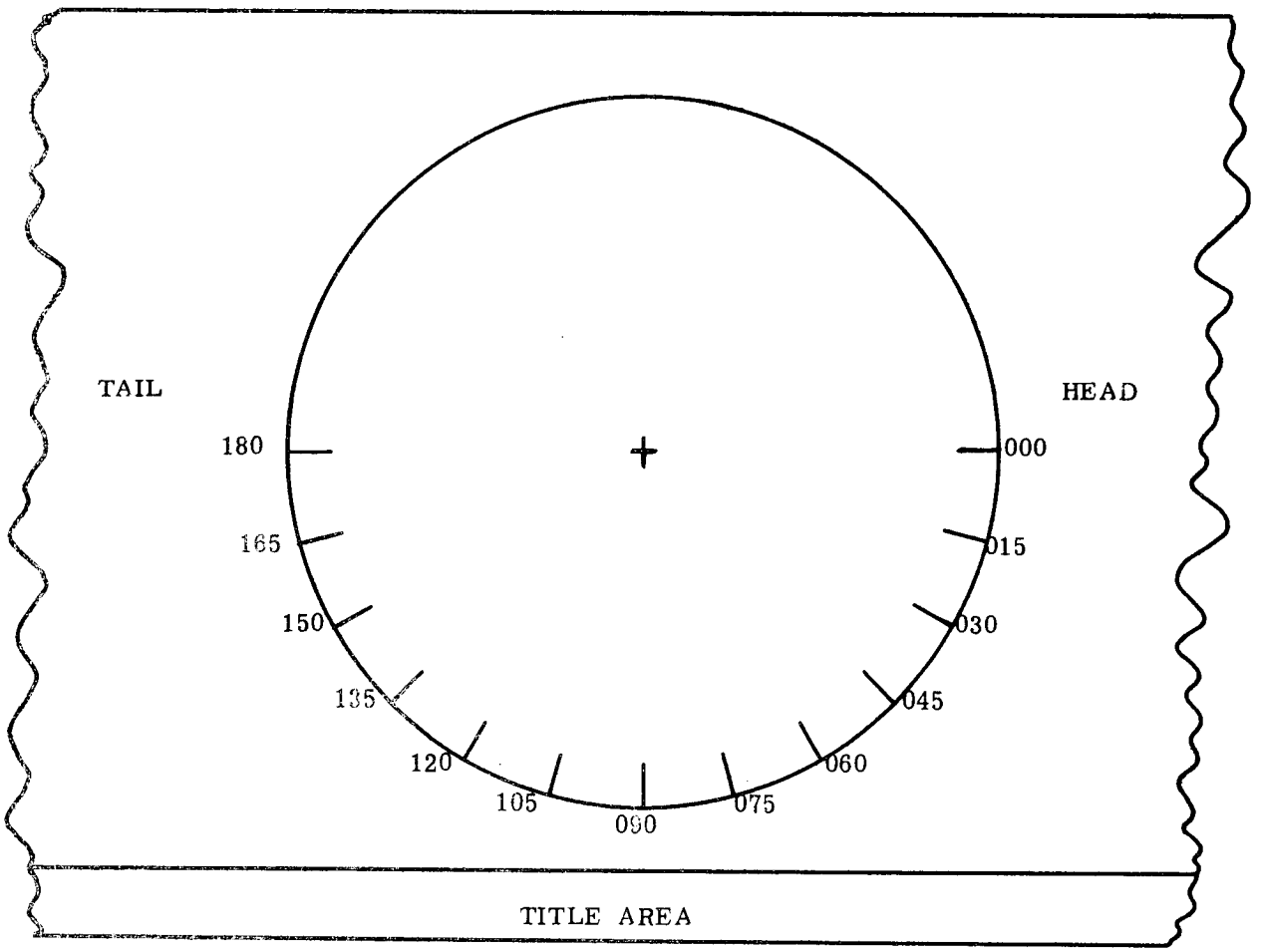
APPENDIX "A"

REFERENCE SYSTEM FOR ORIENTATION OF "J" MISSION EDGES



ORIGINAL NEGATIVE - EMULSION UP

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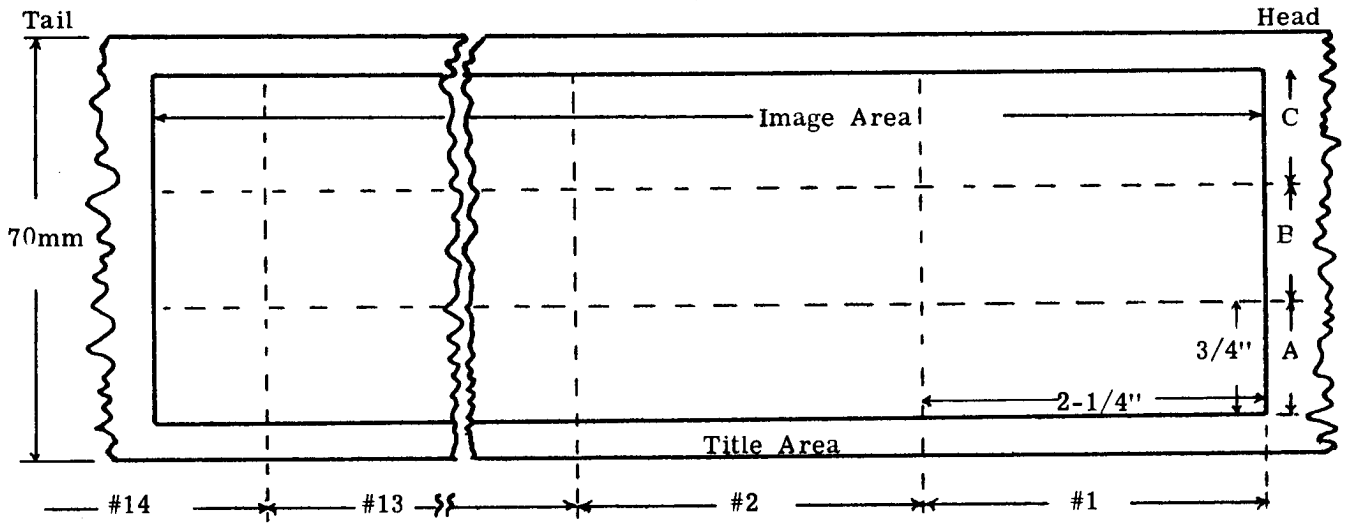
APPENDIX "B"

Grid for Position Identification of Edges



ORIGINAL NEGATIVE ** EMULSION UP

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